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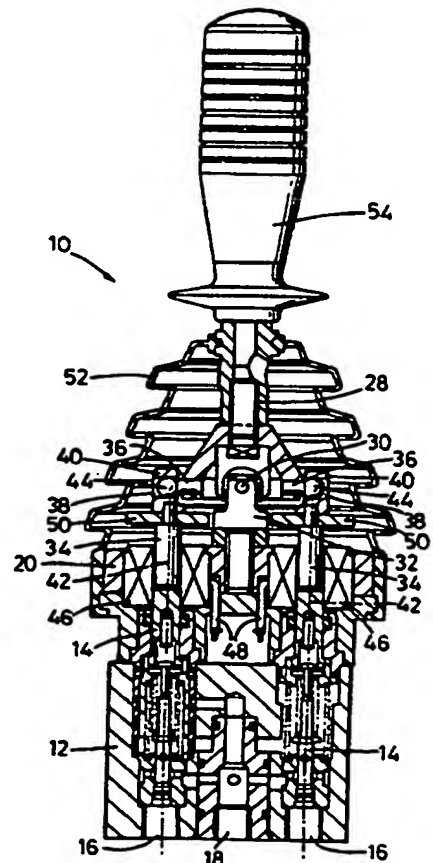
With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: A JOYSTICK ARRANGEMENT

(57) Abstract

A joystick arrangement (10) for selectively actuating a group of valves is disclosed. The arrangement includes a base-plate (12) including four valve-actuating plungers (34) slidably disposed in the base-plate and positioned at the corners of a square with the handle (28), connected to the base-plate by a universal joint (30), at its centre. Four pins (36) project from the handle in a cruciform manner, the end of each of which engages with a slot (38) in the adjacent end of a respective plunger (34). This arrangement ensures that movements of the pin (36) parallel to the axis along which its respective plunger (34) slides are transmitted to the plunger, but movements of the pin (36) of similar magnitude perpendicular to that axis are not. This in turn means that when any one of the plungers (34) is fully depressed, complete freedom of movement of the handle (28) about the other axis is retained to permit depression of either one of the two adjacent plungers (34) as required.



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A JOYSTICK ARRANGEMENT

This invention relates to a joystick arrangement for
5 selectively actuating a group of four spool valves for
controlling a plurality of functions of hydraulically
operated equipment such as a tractor-mounted loader or
excavator.

10 Such arrangements are already known, one of which comprises
a base-plate, a handle connected by a universal joint to
the base-plate, four valve-actuating plungers slidably
disposed in the base-plate at right angles around the
universal joint and four balls connected to a plate secured
15 to the handle and engaging closely in respective sockets
fixed to the adjacent ends of the plungers. The sockets
serve also as armatures of solenoid means which include
coils surrounding the respective plungers.

20 The known arrangements typified by that described in the
preceding paragraph have disadvantages including relative
bulkiness, expense, difficulty of assembly, and high
friction. It is also difficult to control one valve
without interfering with the operation of any adjacent
25 valve which is wholly or partly open.

The object of the present invention is to mitigate the
latter of the aforesaid disadvantages. Mitigation of the
remaining disadvantages are addressed by preferred
30 embodiments of the invention.

According to the invention, a joystick arrangement for
selectively actuating a group of valves comprises a base-
plate, at least two valve-actuating plungers slidably
35 disposed in the base-plate, a handle mounted on the base-
plate and capable of pivoting with respect to the base-
plate about two axes, and at least two pins projecting from
the handle and engaging the adjacent ends of respective
plungers, the engagement between each pin and the adjacent

end of its respective plunger being such that movements of the pin parallel to the axis along which its respective plunger slides are transmitted to the plunger, but movements of the pin of similar magnitude perpendicular to
5 that axis are not.

The handle is connected to the base-plate by a universal joint.

10 Preferably, for convenience of use, the relative angular position of the valve-actuating plungers about the universal joint is 90 degrees.

The ends of the pins may engage in slots in the adjacent
15 ends of their respective plungers.

There may be two plungers in the base-plate, disposed at right angles to each other around the universal joint. There may be three plungers in the base plate, around the
20 universal joint, but preferably there are four such plungers.

Preferably, when four pins are present, they are carried in a cruciform configuration by the handle and the slots are
25 formed at the adjacent ends of the plungers and disposed generally perpendicularly to the longitudinal centre-lines thereof. When two pins are present there may be a similar arrangement, but with the pins being carried in an L-shaped configuration by the handle. When three pins are present
30 there may be a similar arrangement, but with the pins being carried in a T-shaped configuration by the handle.

Preferably, also, the pins have spherical ends.

35 Solenoid means are preferably associated with the respective plungers for the purpose of holding down any one or adjacent two of the plungers which have been fully depressed by movement of the handle.

Preferably, coils for the solenoid means surround the respective plungers within the base-plate, and armatures for the solenoid means are mounted near the said ends of the plungers.

5

Preferably, also, the armatures are loosely mounted on the plungers.

The solenoid means are preferably permanently energised.

10

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings of which:

15 Figure 1 is a side elevation of a joystick arrangement clamped to a valve block;

Figure 2 is a section on the line 2-2 in Figure 1;

20 Figure 3 is a view in the direction of the arrow 3 in Figure 1 showing the underside of the valve block;

Figure 4 is a sectional side elevation on a somewhat larger scale of the joystick arrangement and valve block on the line 4-4 in Figure 2; and

25

Figure 5 is a side elevation on a much larger scale of one of four pin-and-slot connections forming part of the joystick arrangement.

30

Referring now to the drawings, a joystick arrangement indicated generally at 10 is adapted to be clamped as shown to a valve block 12 slidably housing a group of four parallel spool valves 14 which are spring-loaded towards the arrangement. When partially depressed against its spring-loading, each of the valves allows the passage of oil at an infinitely variable reduced pressure through one of the ports 16 to a main control valve (not shown), thus

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acting as a pilot valve. The valve block 12 has an oil inlet port 18.

- A flange 22 of the joystick arrangement 10 is adapted to be clamped to a similar flange 24 on the valve block 12 by means of four bolts (not shown) passing through aligned holes 26 in the flanges. A handle 28 is connected by a universal joint 30 to a short post 32 screwed into the centre of the base-plate 20. Four plungers 34 are slidably and rotatably disposed in the base-plate 20 at right angles around the post 32 carrying the universal joint 30, in alignment and in end-to-end contact with the respective spool valves 14.
- Pin-and-slot connections between the handle 28 and the adjacent ends of the respective plungers 34 comprise pins 36 carried in a cruciform configuration by the handle and slots 38 formed in small plates 40 secured to the adjacent ends of the plungers. The slots 38 are disposed generally perpendicularly to the longitudinal centre-lines 42 of the plungers 34, but have freedom to turn thereon and the pins 36 have spherical ends 44, which are a close sliding fit in the slots 38.
- Solenoid means associated with the respective plungers 34 include coils 46 which surround the plungers within the base-plate 20 and are permanently energised by an electrical current supplied by way of insulated cables 48. The solenoid means also include armatures in the form of annuli 50 which are mounted near the aforesaid ends of the plungers 34 directly beneath the plates 40. The annuli 50 are loosely mounted on the plungers so as to make optimum contact with the tops of the coils 46.
- A corrugated rubber boot 52 encloses the joystick arrangement 10 from the base-plate 20 to the lower end of a hand grip 54 on the handle 28.

In operation, the joystick arrangement 10 has two axes of movement (or degrees of freedom) whereby any one or adjacent two of the plungers 34 can be partially or fully depressed at one time to actuate the associated spool valves 14. When any one of the plungers is fully depressed it is held down by its associated solenoid means whilst complete freedom of movement of the handle 28 about the other axis is retained to permit depression of either one of the two adjacent plungers 34 as required. The pin-and-slot connections permit this because each spherical end 44 can move laterally along its slot 38 as well as co-acting with the upper or lower walls of the slot to move the associated plunger 34 up or down.

15 When any adjacent two of the plungers 34 are both fully depressed at one time, they are held down by their associated solenoid means whilst the handle 28 is held in a fixed position and the other two plungers 34 cannot be moved. The application of sufficient manual force to the

20 handle 28 operates to pull a plunger 34 out of the detaining influence of the associated solenoid means.

Thus there is provided, by the provision of the pin-and-slot connections, a joystick arrangement which is neat and

25 compact, relatively cheap, and easy to assemble, and which allows low friction movement of the handle, such movement being fully retained in one axis even when one of the plungers is held down by its associated solenoid means.

CLAIMS:

1. A joystick arrangement for selectively actuating a group of valves comprising a base-plate, at least two valve-actuating plungers slidably disposed in the base-plate, a handle mounted on the base-plate and capable of pivoting with respect to the base-plate about two axes, and at least two pins projecting from the handle and engaging the adjacent ends of respective plungers, the engagement between each pin and the adjacent end of its respective plunger being such that movements of the pin parallel to the axis along which its respective plunger slides are transmitted to the plunger, but movements of the pin of similar magnitude perpendicular to that axis are not.
2. A joystick arrangement according to claim 1 in which the handle is connected to the base-plate by a universal joint.
3. A joystick arrangement according to claim 1 or claim 2 in which the relative angular position of the valve-actuating plungers about the universal joint is 90 degrees.
4. A joystick arrangement according to any one of claims 1 to 3 in which the ends of the pins engage in slots in the adjacent ends of their respective plungers.
5. A joystick arrangement according to claim 4 in which the slots are disposed generally perpendicularly to the axes along which the plungers can slide.
6. A joystick arrangement according to any preceding claim in which there are two, three or four such plungers in the base-plate.
7. A joystick arrangement according to any preceding claim in which there are four such plungers in the base-plate and four such pins carried in a cruciform configuration by the handle.

8. A joystick according to claim 7 in which there are two such plungers in the base-plate and two such pins carried in an L-shaped configuration by the handle.

5 9. A joystick according to claim 7 in which there are three such plungers in the base-plate and three such pins carried in a T-shaped configuration by the handle.

10. A joystick arrangement according to any preceding
10 claim in which the said pins have spherical ends.

11. A joystick arrangement according to any preceding claim in which solenoid means are associated with the plungers for the purpose of holding down any one or
15 adjacent two of the plungers which have been depressed by movement of the handle.

12. A joystick arrangement according to claim 11 in which coils for the solenoid means surround the respective
20 plungers within the base-plate, and armatures for the solenoid means are mounted near the said ends of the plungers.

13. A joystick arrangement according to claim 12 in which
25 the armatures are loosely mounted on the plungers.

14. A joystick arrangement according to any one of claims 11-13 in which the solenoid means are permanently energised.

30

15. A joystick arrangement for selectively actuating a group of valves as described herein with reference to and as illustrated in the accompanying drawings.

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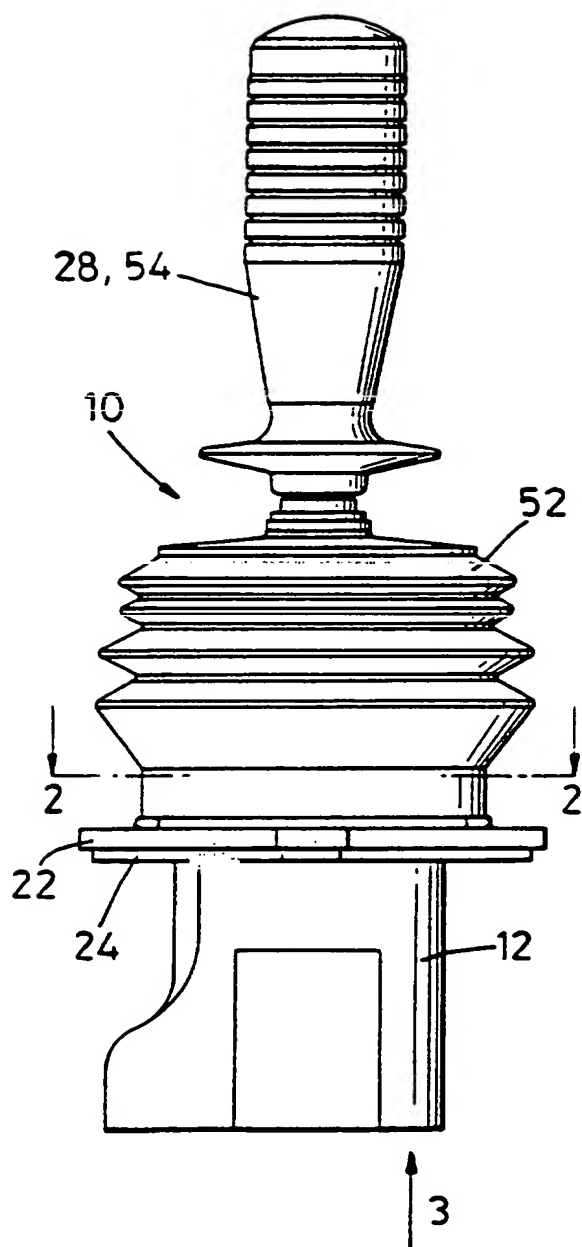


Fig. 1

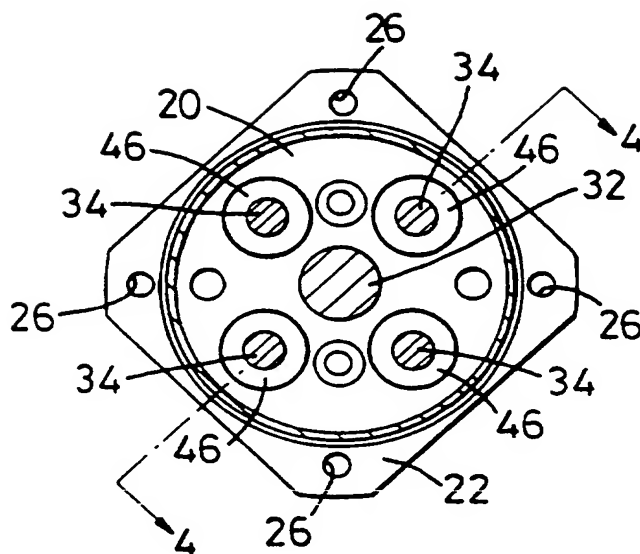


Fig. 2

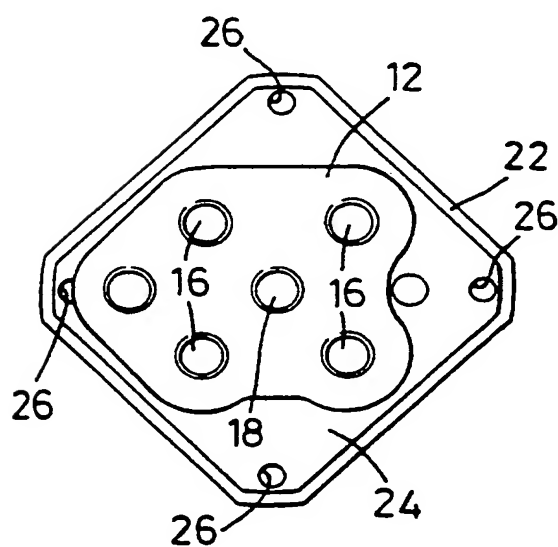


Fig. 3

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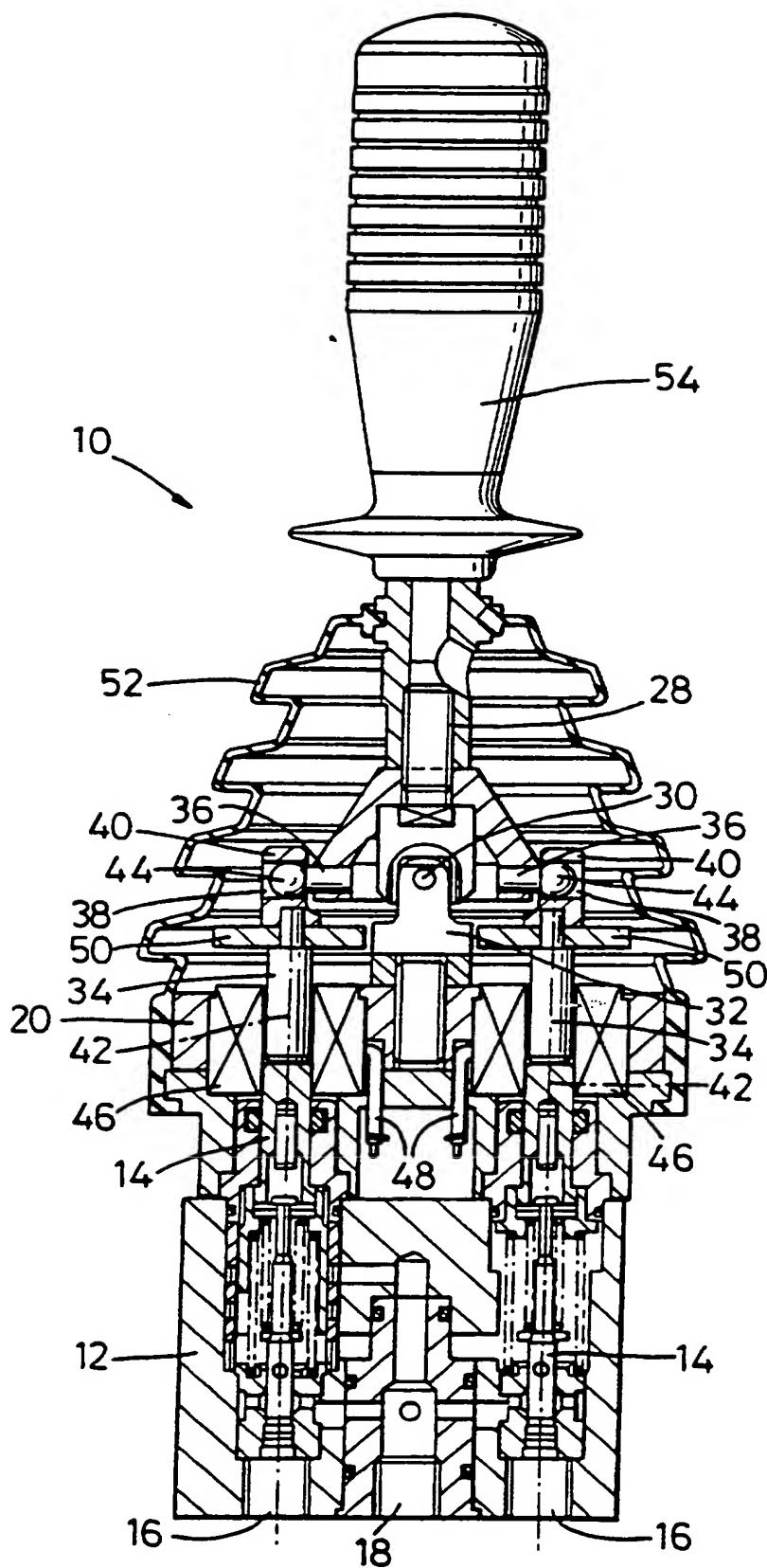


Fig. 4

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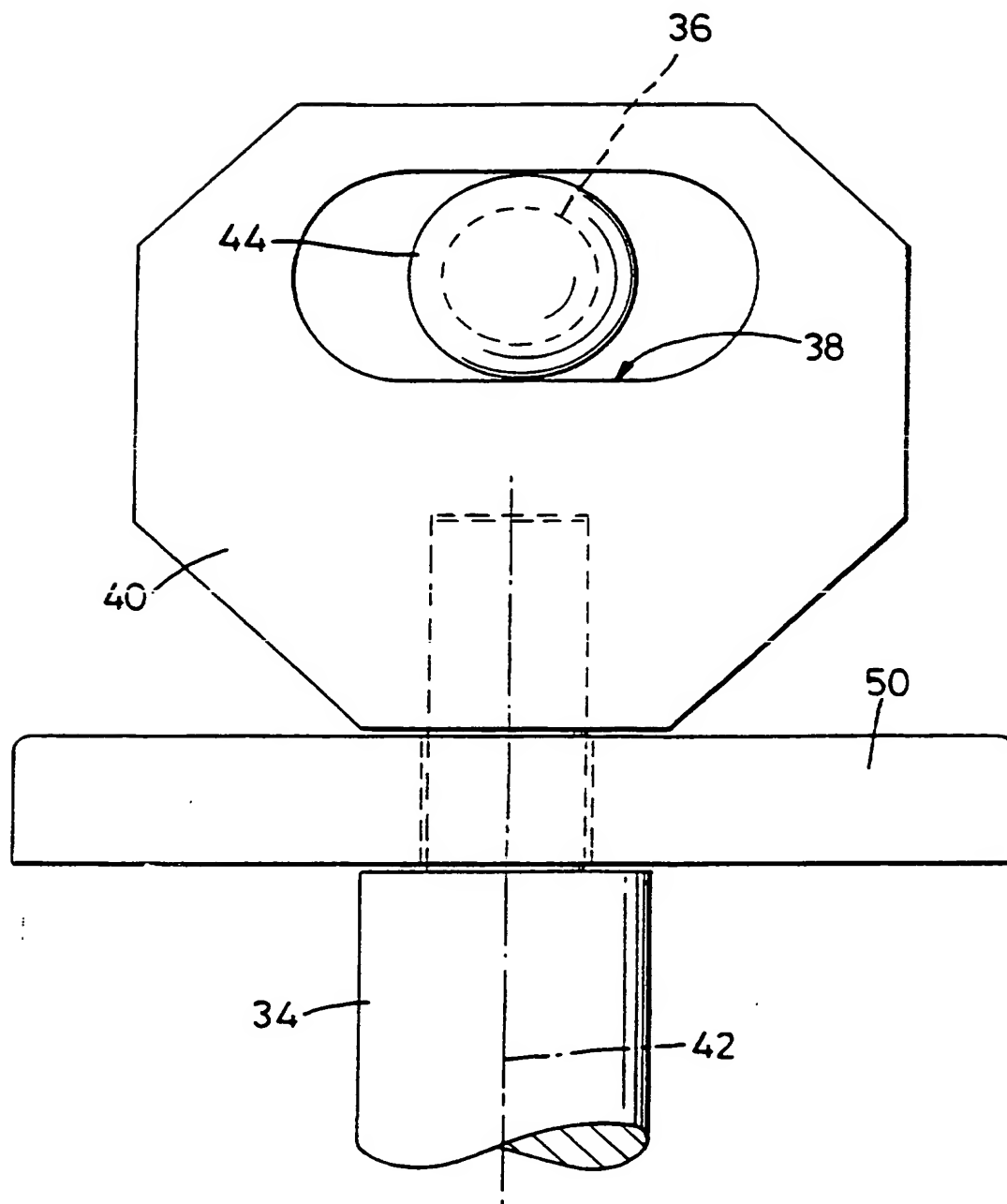


Fig. 5

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INTERNATIONAL SEARCH REPORT

Inter. nat. application No
PCT/GB 96/00768

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F15B13/042

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 F15B E02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE,A,22 62 450 (GENERAL SIGNAL) 9 August 1973 see page 10, paragraph 3 - page 11, paragraph 2; figures 1,2 ---	1-3,6,9
A	FR,A,2 161 013 (WESTINGHOUSE) 6 July 1973 see page 2, line 24 - line 30; figure 1 ---	1-10
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